First Midterm Solutions  
Philosophy 112  
Winter 2002

Answer the following questions in the spaces below them.

1. (7 points each) Give the substitution instance using the constant ‘a’ for each of the following sentences of PL:

   a. \((\exists x)(\exists y)(Gxy \& (\forall z)(Gzxy \supset Byxa))\)

      \((\exists y)(Gay \& (\forall z)(Gzay \supset Byaa))\)

   b. \((\forall y)(\exists x)(\forall z)(Xxz \supset (Gx \equiv Byav))\)

      \((\exists x)(\forall z)(Xxz \supset (G \equiv Baav))\)

2. (9 points) Show all the subformulas of the following PL sentence:

   \((\exists x)[Vcx \& (\forall y)\sim((\forall z)Xxz \lor (\exists z)(Rzc \equiv Cxza))]\)

   \((\exists x)[Vcx \& (\forall y)\sim((\forall z)Xxz \lor (\exists z)(Rzc \equiv Cxza))]\)

   \(Vcx \& (\forall y)\sim((\forall z)Xxz \lor (\exists z)(Rzc \equiv Cxza))\)

   \(Vcx\)

   \(\forall y)\sim((\forall z)Xxz \lor (\exists z)(Rzc \equiv Cxza))\)

   \(\sim((\forall z)Xxz \lor (\exists z)(Rzc \equiv Cxza))\)

   \((\forall z)Xxz \lor (\exists z)(Rzc \equiv Cxza)\)

   \((\forall z)Xxz\)

   \(Xxz\)

   \((\exists z)(Rzc \equiv Cxza)\)

   \(Rzc \equiv Cxza\)

   \(Rzc\)

   \(Cxza\)
3. (7 points each) Symbolize the following sentences in PLI, using the symbolization key provided.

UD: Everything
b: The Bush administration g: The GAO e: The Enron Corporation
Sxy: x is suing y Axy x advised y Ixy: x influenced y
Nxy: x is in y Px: x is a person

a. If anyone who advised the Bush administration influenced it, it was Enron.

\((\exists x)(Ax b & Ix b) \supset (Aeb & Ieb)\)

b. Only those who were advised by Enron are being sued by the GAO.

\((\forall x)(Sgx \supset Aex)\)

c. Whoever in the Bush administration was advised by Enron was influenced by it.

\((\forall x)((Nx b & Aex) \supset Iex)\)
4. (7 points each) Symbolize the following sentences in PLI, using the symbolism key provided.

UD: Positive integers (1, 2, 3, . . .)

f: four  Gxy: x is greater than y
o: one   Lxy: x is less than y

a. The positive integer that is less than all others is one.

\((\exists x)[((\forall y)(\sim x = y \supset Lxy) \& (\forall z)((\forall w)(\sim z = w \supset Lzw) \supset x = z)) \& x = o]\)

b. No positive integer is greater than every positive integer.

\(\sim (\exists x)(\forall y)Gxy\)

c. Exactly two positive integers are less than four and greater than one.

\((\exists x)(\exists y)[((Lxf \& Gxo) \& (Lyf \& Gyo)) \& \sim x = y) \& (\forall z)((Lzf \& Gzo) \supset\( (x = z \lor y = z))\)]
5. (7 points each) Symbolize the following sentences in $PLI$, providing your own symbolization key.

Symbolization key

UD: Animals
Ex: x is an elephant    Mx: x is a mouse    Lx: x is large mouse
Sx: x is a small elephant    Lxy: x is larger than y
Exy: x eats more than y

a. Small elephants eat more than large mice.

$(\forall x)(Sx \supset (\forall y)(Ly \supset Exy))$

b. Elephants are afraid of mice, but not of themselves.

$(\forall x)(Ex \supset ((\forall y)(My \supset Axy) \& \sim Axx))$

c. Every elephant is larger than some animal, but some animal is larger than every elephant.

$(\forall x)(Ex \supset (\exists y)Lxy) \& (\exists x)(\forall y)(Ey \supset Lxy)$
6. (7 points each) Give fluent readings of the following sentences of PLI, using the symbolization key provided.

UD: Everything

d: Grey Davis  Rx: x is a Republican  Dx: x is a Democrat
r: Richard Riordan  Cx: x is conservative  Mx: x is a moderate
Px: x is a person  Bxy: x can beat y

a. $(\forall x)(\forall y)(((Cx \& Dx) \& Byx) \supset (Mx \& Ry))$

Only a moderate Republican can beat a conservative Democrat.

b. $(\exists x)[([Px \& (Rx \& Bxd)] \& (\forall y)([Py \& (Ry \& Byd)] \supset x = y)) \& x = r]$

Richard Riordam is the Republican who can beat Grey Davis.